IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Ubaldo Mastromatteo
Application No.	:	10/060,068
Filed	:	January 29, 2002
For	:	PROCESS FOR SEALING AND CONNECTING PARTS OF ELECTROMECHANICAL, FLUID AND OPTICAL MICROSYSTEMS AND DEVICE OBTAINED THEREBY
Examiner	:	Shrinivas H. Rao
Art Unit	:	2814
Docket No.	:	854063.670
Date	:	January 3, 2007

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANT'S BRIEF

Commissioner for Patents:

This brief is in furtherance of the Notice of Appeal, filed in this case on October 31, 2006. The fees required under Section 1.17(c), and any required request for extension of time for filing this brief and fees therefor, are dealt with in the accompanying transmittal letter.

I. REAL PARTY IN INTEREST

STMicroelectronics S.r.l. is the assignee of the present application and is the real party in interest.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF CLAIMS

Claims 13-20, 27-33, 35-40, and 55-66 are pending and are rejected. Claims 1-12, 21-26, 34, and 41-54 were canceled. The rejections of claims 13-20, 27-33, 35-40, 57-59, and 63-65 are being appealed.

IV. STATUS OF AMENDMENTS

An amendment was filed on August 31, 2006, which traversed the rejections and attempted to amend claim 55 to include the elements of claim 57, which depends on claim 55, and cancel claim 56. On September 28, 2006, the Examiner issued an advisory action disagreeing with the arguments traversing the rejections. The Examiner refused to enter the amendment and indicated that the proposed amendment raised new issues, without explaining how incorporating dependent claim 57 into independent claim 55 would raise new issues.

Another amendment was filed on October 31, 2006. The October 31 amendment again attempted to cancel claim 56 and amend claim 55 to include the elements of claim 57. The applicant explained that the amendment would reduce the issues for appeal, by reducing the number of claims appealed, rather than raise new issues. No response to the October 31 amendment has been received.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The invention relates generally to microsystem devices having two or more bodies, such as semiconductor wafers, that are mechanically and electrically attached to one another. In prior art microsyem devices, the bodies are mechanically bonded together by an adhesive and are electrically connected by wires that are soldered to bonding pads on surfaces of the bodies. Such prior art microsystem devices require extra sealing structures to protect the circuits on the bodies and the wires.

One embodiment of the invention is directed to an electromechanical or optical microsystem device 1 that includes first and second bodies 2, 3 that are welded together by a mechanical and electrical connection structure 20, 21 (Figs 1-3; page 2, lines 8-14; page 3, line 2 – page 6, line 7). The mechanical and electrical connection structure comprises an electrically conductive region 20 welded between the two bodies 2, 3 (page 2, lines 8-14; page 3, lines 17-

26; page 4, lines 22-29) and a spacing region 21 that surrounds the conductive region 20 and an active region 29 of said electromechanical microsystem (page 5, lines 5-20).

Such a welded mechanical and electrical connection structure 20, 21 enables the two bodies 2, 3 to be firmly bonded and electrically connected to one another (page 5, lines 1-4). In addition, the welded mechanical and electrical connection structure 20, 21 also enables the conductive region 20 and active region 29 to be sealed within respective cavities 22, thereby preventing damage to the conductive region 20 and active region 29 (page 5, lines 5-7 and lines 21-23). Also, welding the bodies together, rather than attaching them together by an adhesive layer, enables them to self-align with one another because the melted material of the conductive region 20 acts like a spring to draw together metal regions 9, 19 on the bodies 2, 3, respectively.

The following shows claims 13-15[1] and 27-29 with reference numbers indicating those claims being read on the embodiment of Figures 1-3. Of course, the reference numbers are exemplary only and are not intended to limit the claims only to the exact embodiment shown in Figures 1-3.

13. A device forming an electromechanical or optical microsystem, the device comprising:

a first body 2 and a second body 3 welded together through a mechanical and electrical connection structure 20, 21, the mechanical and electrical connection structure comprising:

an electrically conductive region 20 welded between said first body and said second body; and

a unitary spacer 21 arranged near said electrically conductive region and extending between the first and second bodies, the spacer having at least three sides defining a first cavity surrounding an active region 29 or a plug 20 of the electromechanical or optical microsystem.

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[1] Claims 57-59 are not being listed separately because those claims are not being argued separately from claims 13-15, respectively.

14. The device according to claim 13, wherein said electrically conductive region is of a low-melting eutectic material (page 3, lines 24-26).

15. The device according to claim 14, wherein said low-melting eutectic material is formed by alternating layers of gold and tin (page 3, lines 24-26).

27. A device forming an electromechanical or optical microsystem, comprising:

a first body 2 of semiconductor material;

a first metal region 9, formed on a first surface 5a of the first body;

a second body 3 of semiconductor material spaced apart from the first body;

a spacer 21 separating the first and second body and in contact with the first surface of the first body and a first surface 13a of the second body, the spacer having at least three sides defining a first cavity 22 between the first and second bodies;

a second metal region 19, formed on a first surface 13a of the second body 3; and

a connection structure 20 bonded to the first and second metal regions, forming thereby an electrical connection between the first and second metal regions, the connection structure being surrounded by the first cavity 22.

28. The device of claim 27 wherein the connection structure is a low-melting eutectic material welded to the first and second metal regions (page 3, lines 24-26).

29. The device of claim 27 wherein, the first and second metal regions 9, 19 and the connection structure 20 are formed within the first cavity defined by the spacer (Fig. 2).

Another embodiment of the invention is directed to an electromechanical optical microsystem device that includes a first body 35 and second and third bodies 44, 50 welded to the first body 35 by a mechanical and electrical connection structure 41 (Figs 6-7; page 6, line 8 – page 7, line 9). The mechanical and electrical connection structure 41 comprises electrically conductive regions 38 welded between the bodies 35, 44, 50 and a spacing region 39 that

surrounds the conductive region 38 and an active region 36, 47-49 of said electromechanical microsystem (page 6, line 8 – page 7, line 9). The active region 36, 47-49 includes optical devices such as a mirror 36, light-emitting diode 47, diffractive lens 48, and mirror 49, that become properly aligned with one another when the bodies are welded together by the conductive regions 38.

The following shows claims 27-29, 32-39, 55, and 64-65 with reference numbers indicating those claims being read on the embodiment of Figures 6-7. Of course, the reference numbers are exemplary only and are not intended to limit the claims only to the exact embodiment shown in Figures 6-7. In particular, independent claims 27 and 55 also read on the embodiment of Figures 1-3.

27. A device forming an electromechanical or optical microsystem, comprising:

a first body 35 of semiconductor material;

a first metal region 37, formed on a first surface 35b of the first body;

a second body 44 of semiconductor material spaced apart from the first body;

a spacer 39 separating the first and second body and in contact with the first surface of the first body and a first surface of the second body, the spacer having at least three sides defining a first cavity 40 between the first and second bodies (Fig. 7);

a second metal region 45, formed on a first surface 44a of the second body; and

a connection structure 38 bonded to the first and second metal regions 37, 45, forming thereby an electrical connection between the first and second metal regions, the connection structure being surrounded by the first cavity (Figs. 6-7; page 6, lines 12-28).

28. The device of claim 27 wherein the connection structure is a low-melting eutectic material welded to the first and second metal regions (page 3, lines 24-26; page 7, lines 8-9).

29. The device of claim 27 wherein, the first and second metal regions 37, 45and the connection structure are formed within the first cavity defined by the spacer (Fig. 7).

32. The device of claim 31, further comprising a mirror 36 formed on a second surface 35a of the first body 35.

33. The device of claim 31, further comprising a diffractive lens 48 formed on the second surface 35a of the first body 35.

35. The device of claim 13, wherein the active region comprises a suspended electromechanical structure 29 (Fig. 3).

36. The device of claim 13, wherein the active region comprises an optical structure 36, 47-49 (Fig. 6).

37. The device of claim 36, further comprising a mirror 36, 49 formed on a surface of the first body opposite the optical structure.

38. The device of claim 36, further comprising:

a third body 50 welded to the first body 35 adjacent to the second body 44; and

an additional spacer 38 formed between the first and third bodies and including a completely enclosed second cavity 40 surrounding an additional active region of the microsystem.

39. The device of claim 38, further comprising first and second mirrors 36, 49 formed on opposite faces of the first body.

55. A device forming an electromechanical or optical microsystem, the device comprising:

a first body 35;

a second body 44 spaced apart from the first body;

an active region 47 of the microsystem, the active region being positioned between the first and second bodies; and

a single spacer 39 extending between the first and second bodies and including a completely enclosed first cavity 40 that surrounds the active region and that is defined by the spacer and the first and second bodies.

64. The device of claim 63, further comprising a mirror 36 formed on a surface of the first body opposite to the optical structure 47, 49.

65. The device of claim 55, further comprising:

a third body 50 welded to the first body 35 and adjacent to the second body 44; and

an additional spacer 39 extending between the first and third bodies and including a completely enclosed second cavity 40 that surrounds an additional active region of the microsystem.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 13-16, 18, 27-29, 55-58, 60, 62, and 65 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,465,271 to Ko et al. ("Ko").

Claims 15, 17, 30, 59, 61-62, and 65 were rejected under 35 U.S.C. § 103 as being unpatentable over Ko in view of U.S. Patent No. 5,633,535 to Chao et al. ("Chao")[2].

Claims 19-20, 31, 59, 63-64, and 66 were rejected under 35 U.S.C. § 103 over Ko and Chao in view of Yew et al. (U.S. 6,137,164, hereafter "Yew").

Claims 32-33 and 35-40 were rejected under 35 U.S.C. § 103 over Ko, Chao, and Yew in view of Duboz et al. (U.S. 5,726,500, hereafter "Duboz").

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[2] The Examiner noted on page 4 of the May 31, 2006 final Office Action that claims "17-61, 30, 62" were being rejected, but pages 4-6 discuss claims 15, 17, 30, 59, 61-62, and 65 and claims 21-26, 34, and 41-54 were already canceled, so the applicant believes that the Examiner intended to reject claims 15, 17, 30, 59, 61-62, and 65 and not "17-61, 30, 62." If that belief is not correct, then the Examiner is requested to clarify the rejection.

VII. ARGUMENT

A. Novelty

1. Law

Federal Circuit decisions repeatedly emphasize that anticipation is established only if all the elements of an invention, as stated in a patent claim, are identically set forth in a single prior art reference. *Motorola, Inc. v. Interdigital Technology Corp.*, 121 F.3d 1461, 1473, 43 USPQ2d 1481, 1490 (Fed. Cir. 1997). Although the disclosure requirement presupposes the knowledge of one skilled in the art, that presumed knowledge does not grant a license to read into the prior art reference teachings that are not there. *Id.* Also, although it is permissible for the prior art reference to disclose one of the claimed elements by inherency, the mere fact that a certain thing may result is insufficient to establish such disclosure by inherency. *In re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1431 (Fed. Cir. 1997). In addition, anticipation requires that the prior art reference enable one skilled in the art to make and use the invention. Bristol-Myer Squibb Co. v. Ben Venue Laboratories, Inc., 246 F.3d 1368, 1374, 58 USPQ2d 1508 (Fed. Cir. 2001).

2. Claims 13, 16, 18, 40, and 57

Ko does not disclose the invention recited in claim 13. Claim 13 recites a device that includes "a first body and a second body welded together through a mechanical and electrical connection structure." Ko does not disclose such first and second bodies welded together through a mechanical and electrical connection structure. Instead, Ko repeatedly states that a diaphragm 152 of a wafer B is silicon fusion bonded to a wafer A (see Abstract, lines 9-14; Summary of the Invention, col. 5, lines 62-63). As known in the art, such silicon fusion bonding is not welding. As described in the attached pages 70-72 from "Silicon Processing for the VLSI Era," volume 2, by Stanley Wolf, silicon fusion bonding involves a chemical reaction of oxygen from a silicon dioxide with the silicon from two wafers. That is not welding, which instead involves uniting two materials by melting.

Ko also does not disclose "an electrically conductive region welded between said first body and said second body," as recited in claim 13. Ko does not disclose such an

electrically conductive region welded between first and second bodies, for at least three reasons. First, Ko states that the diaphragm 152 of wafer B is silicon fusion bonded to the surface of wafer A via an intermediary oxide layer 104a" (see col. 9, lines 50-52 and Figs. 1E-1L). As is well known, such an oxide layer 104a" is not an electrically conductive region and is not welded.

Second, Ko also discloses a bottom electrode 112a on the wafer A, but explicitly requires that the electrode 112a not be made of any common metal because the silicon fusion bonding temperature is too high (col. 11, lines 17-27). Ko instead forms the electrode 112a of a "boron heavily diffused layer" of the substrate 102 of wafer A. Such an electrode 112a is not welded and is part of the substrate 102 of wafer A rather than being between the wafers A and B.

Third, Ko does not provide an enabling disclosure of an electrically conductive region welded between the two bodies. As mentioned above, Ko explicitly states that materials having a eutectic temperature lower than the silicon fusion bonding temperatures, such as most metals, cannot be used for any of the conductive areas of Ko (col., 11, lines 17-30). Ko lists several problems that would result if such low eutectic temperature materials were used. As such, Ko has not enabled one skilled in the art to use a conductive material that would melt and become welded between two bodies.

The Examiner incorrectly asserted, in the Advisory Action dated September 28, 2006, that col. 3, lines 35-45 of Ko teaches the feature of a welded electrically conductive region. That section of Ko does not mention any conductive region welding. Instead, that section mentions that a metal feedthrough could be positioned between a glass substrate and a glass insulating layer, and "a suitable heat treatment will cause the glass insulating layer to deform and seal the space around the feedthrough ...." A "glass insulating layer" is certainly not an electrically conductive region, and thus, that section of Ko does not disclosure a welded electrically conductive region.

In addition, that section of column 3 of Ko does not even refer to the device of Figures 1A-1L upon which the Examiner relies. Instead, that section refers to another patent, U.S. Patent No. 5,528,452 to Ko et al. ("Ko II"), which describes in columns 6-7 a process in which a wafer 42 is bonded to a substrate 14 with a conductive feedthrough layer 26, insulating layer 32, and an electrode 24. The paragraph at col. 6, lines 54-65 describes a thermal treatment that deforms the insulating layer 32 around the electrode 26. Rather than teaching welding of the

electrode 26, that paragraph teaches that the electrode 26 is not melted, because if both the electrode 26 and the insulating layer 32 were melted, it does not seem that the insulating layer 32 would "deform around the electrode 26" as recited in the '452 patent.

For the foregoing reasons, claim 13 is not anticipated by Ko.

3. Claims 14 and 58

Ko does not disclose the invention recited in claim 14, which depends on claim 13. Claim 14 recites that the electrically conductive region is of a low-melting eutectic material. The oxide layer 104a" and the electrode 112a of Ko are certainly not of a low-melting eutectic material. As discussed above, Ko explicitly states a low-melting eutectic material cannot be used, and thus, Ko has not enabled the use of such a low-melting eutectic material. Accordingly, claim 14 is not anticipated by Ko.

4. Claim 15

Ko does not disclose the invention recited in claim 15, which also depends on claim 13. Claim 15 further recites that the low-melting eutectic material is formed by alternating layers of gold and tin. Ko never mentions gold, tin, or any alternating layers of materials. The Examiner notes that gold and tin are well-known eutectic materials, but that is not disclosed by Ko, either explicitly or inherently. In addition, even if Ko had mentioned that gold and tin are well-known eutectic materials, that still would not disclose employing alternating layers of gold and tin. Accordingly, claim 15 is not anticipated by Ko.

5. Claim 27

Ko does not disclose the invention recited in claim 27. Claim 27 recites a device that includes a first metal region formed on a first surface of a first body, a second metal region formed on a first surface of a second body, and a connection structure bonded to the first and second metal regions and forming an electrical connection between the first and second metal regions. As discussed above, the oxide layer 104a" and the electrode 112a are not metal regions. Even if one ignored the explicit teaching of Ko against using a metal for the electrode 112a, one

would still not satisfy the claim language because there would still be no metal region on the wafer B/diaphragm 152 and there would still be no electrical connection structure bonded to the electrode 112a or to the non-existent metal region of the wafer B/diaphragm 152. Indeed, there can be no electrical connection structure bonded from a metal region of the wafer B/diaphragm 152 to the electrode 112a, because the oxide layer 104a" completely covers the electrode 112a (see Figure 1F). Accordingly, claim 27 is not anticipated by Ko.

6. Claim 28

Ko does not disclose the invention recited in claim 28, which depends on claim 27. Claim 28 recites that the connection structure is a low-melting eutectic material welded to the first and second metal regions. As discussed above, there is no electrical connection structure connected to either the oxide layer 104a" or the electrode 112a, so Ko cannot possibly disclose that such a non-existent structure is a low-melting eutectic material. Also, as discussed above, Ko explicitly states a low-melting eutectic material cannot be used, and thus, Ko has not enabled the use of such a low-melting eutectic material. Accordingly, claim 28 is not anticipated by Ko.

7. Claim 29

Ko does not disclose the invention recited in claim 29, which depends on claim 27. Claim 29 recites that the first and second metal regions and the connection structure are formed within the first cavity defined by the spacer. As discussed above, there are no such metal regions on the wafers A, B and no electrical connection structure between such metal regions, so Ko cannot possibly disclose that such non-existent structures are formed in a first cavity. Accordingly, claim 29 is not anticipated by Ko.

8. Claim 65

Ko does not disclose the invention recited in claim 65, which depends on claim 55. Claim 65 recites a third body welded to the first body and an additional spacer extending between the first and third bodies. Ko does not disclose such a welded third body or an

additional spacer. As discussed above, Ko does not disclose welding any bodies together, and thus, cannot disclose a third body welded to a first body. Also, even if the wafer B and the doped layer 152 of the wafer B were considered second and third bodies, Ko still would not disclose an additional spacer extending between the first and third bodies. The oxide layer 104a" extends between the wafer A and the doped layer 152, but there is no additional spacer extending between the wafer A and the wafer B or any other body. Accordingly, claim 65 is not anticipated by Ko.

B. Nonobviousness

1. Case law

The Federal Circuit has held many times that the Examiner must provide objective evidence of a motivation for combining the teachings of cited references in the manner claimed. *E.g., In re Sang-Su Lee*, 277 F.3d 1338, 1343; 61 USPQ2d 1430, 1433 (Fed. Cir. 2002) (copy enclosed). Further, "this factual question of motivation is material to patentability, and could not be resolved on subjective belief and unknown authority." *Id.* at 277 F.3d 1343-1344; 61 USPQ2d 1433. Moreover, "the mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260, 1266; 23 USPQ2d 1780, 1783-84.

2. Rejections based on Ko and Chao

a) Claim 15

Ko does not disclose the invention recited in claim 15, which also depends on claim 13. As discussed above, Ko does not teach "a first body and a second body welded together through a mechanical and electrical connection structure" or "an electrically conductive region welded between said first body and said second body," as recited in claim 13. In fact, Ko explicitly teaches away from such welded structures by stating that the "conductive areas cannot

uses common metals … since the SFB annealing temperature is normally higher that the eutectic temperature of most metals with the silicon substrate material" (col. 11, lines 22-27). As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such welded structures.

Ko and Chao also do not teach or suggest the features recited in claim 15. Claim 15 recites that the electrically conductive region is a low-melting eutectic material formed by alternating layers of gold and tin. Neither Ko nor Chao mentions gold, tin, or alternating eutectic layers. The Examiner notes that gold and tin are well known eutectic materials, but that does not satisfy the claim language which requires alternating layers of gold and tin. The Examiner has not pointed to any teaching or suggesting of such alternating layers of any eutectic materials.

Accordingly, claim 15 is nonobvious in view of Ko and Chao.

b) Claims 17 and 61-62

Ko and Chao do not teach or suggest the invention recited in claim 17, which also depends on claim 13. As discussed above, Ko does not teach "a first body and a second body welded together through a mechanical and electrical connection structure" or "an electrically conductive region welded between said first body and said second body," as recited in claim 13. In fact, Ko explicitly teaches away from such welded structures by stating that the "conductive areas cannot uses common metals … since the SFB annealing temperature is normally higher that the eutectic temperature of most metals with the silicon substrate material" (col. 11, lines 22-27). As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such welded structures. [3]

c) Claim 30

Ko and Chao do not teach or suggest the invention of claim 30, which depends on claim 27. As discussed above, claim 27 recites a device that includes a first metal region formed

[3] If the Examiner also intended to reject claims 18-20 and 35-40 based on Ko and Chao, such a rejection would be incorrect for at least the reasons discussed for claim 17, given that claims 18-20 and 35-40 also depend on claim 13.

on a first surface of a first body, a second metal region formed on a first surface of a second body, and a connection structure bonded to the first and second metal regions and forming an electrical connection between the first and second metal regions. Like Ko, Chao does not teach or suggest a second metal region formed on a first surface of a second body or an electrical connection structure between first and second metal region. Instead, Chao simply discloses solder bumps 42 extending between the substrates 10, 20. Those solder bumps cannot be the first and second metal regions and the electrical connections structure of claim 27. In addition, one would not be motivated to combine the metal solder bumps 42 of Chao with the structure of Ko because Ko explicitly teaches away from using such metallic connections (col. 11, lines 22-30). Accordingly, claim 30 is nonobvious in view of Ko and Chao.[4]

d) Claim 65

Ko and Chao do not teach or suggest the invention recited in claim 65, which depends on claim 55. Claim 65 recites a third body welded to the first body and an additional spacer extending between the first and third bodies. As discussed above, Ko does not teach or suggest such a welded third body or an additional spacer. Figure 4 of Chao shows plural bodies 10 coupled to the substrate 20, but does not show separate spacers between the bodies 10 and the substrate 20. Accordingly, claim 65 is nonobvious in view of Ko and Chao.

3. Rejections based on Ko, Chao, and Yew

a) Claims 19-20

The combination of Ko, Chao, and Yew does not teach or suggest the invention recited in claims 19-20, which depend on claim 13. As discussed above with respect to claims 15 and 17, Ko explicitly teaches away from any welded structures, including the welded structures recited in claim 13. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such welded structures. Accordingly, claims 19-20 are not rendered obvious by the cited prior art.

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[4] If the Examiner also intended to reject claims 27-33 based on Ko and Chao, such a rejection would be incorrect for at least the reasons discussed for claim 30, given that claims 28-33 depend on claim 27.

b) Claim 31

The combination of Ko, Chao, and Yew does not teach or suggest the invention recited in claim 31, which depends on claim 27. As discussed above with respect to claim 30, Ko explicitly teaches away from any metallic structures, including the metal regions recited in claim 27. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such metal regions. Accordingly, claim 31 is not rendered obvious by the cited prior art.

c) Claim 59

The combination of Ko, Chao, and Yew does not teach or suggest the invention recited in claim 59, which depends on claims 55 and 58. Claim 59 recites that the low-melting eutectic material of the electrically conductive region is formed by alternating layers of gold and tin. None of Ko, Chao, and Yew mentions gold, tin, or alternating eutectic layers. The Examiner notes that gold and tin are well known eutectic materials, but that does not satisfy the claim language which requires alternating layers of gold and tin. The Examiner has not pointed to any teaching or suggesting of such alternating layers of any eutectic materials. Accordingly, claim 59 is nonobvious in view of Ko, Chao, and Yew.

d) Claim 63

The combination of Ko, Chao, and Yew does not teach or suggest the invention recited in claim 63, which depends on claim 55. Claim 63 recites that the active region comprises an optical structure. None of Ko, Chao, and Yew mentions any optical structure and the Examiner does not point to any such teaching. Accordingly, claim 63 is nonobvious in view of Ko, Chao, and Yew.

e) Claim 64

The combination of Ko, Chao, and Yew does not teach or suggest the invention recited in claim 64, which depends on claims 55 and 63. Claim 64 recites a mirror formed on a surface of the first body opposite to the optical structure. None of Ko, Chao, and Yew mentions any mirror and the Examiner does not point to any such teaching. Accordingly, claim 64 is nonobvious in view of Ko, Chao, and Yew.

4. Rejections based on Ko, Chao, Yew, and Duboz

a) Claim 32

The combination of Ko, Chao, Yew, and Duboz does not teach or suggest the invention recited in claim 32, which depends on claim 27. As discussed above with respect to claim 31, Ko explicitly teaches away from any metallic structures, including the metal regions recited in claim 27. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such metal regions.

In addition, the cited references do not teach or suggest the features of claim 32, which recites a mirror formed on a second surface of the first body. The Examiner states that col. 4, lines 29-32 teaches such a mirror, but the applicants have found no such reference to any mirror in those lines, let alone a mirror formed on a second surface of a first body. Those lines of Duboz state that the device includes "read and multiplexing circuits enabling signals representing illuminations individually received by each of the photosensitive elements 31 to be read individually …." Duboz details the structure of the photosensitive elements 31 at col. 5, lines 35-55 without ever suggesting any mirror. In addition, the photosensitive elements are not on a second surface of a first body having a first surface on which a first metal region is formed.

For the foregoing reasons, claim 32 is nonobvious in view of Ko, Chao, Yew, and Duboz.

b) Claim 33

The combination of Ko, Chao, Yew, and Duboz does not teach or suggest the invention recited in claim 33, which depends on claim 27. As discussed above with respect to

claim 31, Ko explicitly teaches away from any metallic structures, including the metal regions recited in claim 27. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such metal regions.

In addition, the cited references do not teach or suggest the features of claim 33, which recites a diffractive lens formed on a second surface of the first body. The Examiner states that col. 5, lines 10-17 teaches such a diffractive lens, but the applicants have found no such reference to any diffractive lens in those lines, let alone a diffractive lens formed on a second surface of a first body. Those lines of Duboz state that the metallic connections 34 must be transparent to the wavelengths detected by the photosensitive elements. Such transparent connections 34 are certainly not diffractive lenses. In addition, the metallic connections are not on a second surface of a first body having a first surface on which a first metal region is formed.

For the foregoing reasons, claim 33 is nonobvious in view of Ko, Chao, Yew, and Duboz.

c) Claims 35-36, 38, and 40

The combination of Ko, Chao, Yew, and Duboz does not teach or suggest the invention recited in claim 35-36, 38, and 40, which depend on claim 13. As discussed above with respect to claims 19-20, Ko explicitly teaches away from any welded structures, including the welded structures recited in claim 13. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such welded structures. Accordingly, claims 35-36, 38, and 40 are not rendered obvious by the cited prior art.

d) Claim 37

Claims 32-33 and 35-40 were rejected under 35 U.S.C. § 103 over Ko, Chao, and Yew in view of Duboz et al. (U.S. 5,726,500, hereafter "Duboz").

The combination of Ko, Chao, Yew, and Duboz does not teach or suggest the invention recited in claim 37, which depends on claims 13 and 36. As discussed above with respect to claims 19-20, Ko explicitly teaches away from any welded structures, including the welded structures recited in claim 13. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such welded structures.

In addition, the cited prior art does not teach or suggest the features of claim 37, which recites a mirror formed on a surface of the first body opposite to the optical structure. As discussed above with respect to claim 32, the cited prior art does not teach or suggest any mirror, let alone a mirror formed on a surface opposite to an optical structure.

Accordingly claim 37 is not rendered obvious by the cited prior art.

e) Claim 39

The combination of Ko, Chao, Yew, and Duboz does not teach or suggest the invention recited in claim 39, which depends on claims 13, 36, and 38. As discussed above with respect to claims 19-20, Ko explicitly teaches away from any welded structures, including the welded structures recited in claim 13. As such, one skilled in the art would have been explicitly motivated away from combining Ko with any reference that employed such welded structures.

In addition, the cited prior art does not teach or suggest the features of claim 39, which recites first and second mirrors formed on opposite faces of the first body. As discussed above with respect to claim 32, the cited prior art does not teach or suggest any mirror. Even if the photosensitive elements of Duboz were mirrors, claim 39 would still be nonobvious because Duboz does not suggest forming the photosensitive elements on opposite faces of the first body.

Accordingly claim 39 is not rendered obvious by the cited prior art.

VIII. CLAIMS APPENDIX

13. A device forming an electromechanical or optical microsystem, the device comprising:

a first body and a second body welded together through a mechanical and electrical connection structure, the mechanical and electrical connection structure comprising:

an electrically conductive region welded between said first body and said second body; and

a unitary spacer arranged near said electrically conductive region and extending between the first and second bodies, the spacer having at least three sides defining a first cavity surrounding an active region or a plug of the electromechanical or optical microsystem.

14. The device according to claim 13, wherein said electrically conductive region is of a low-melting eutectic material.

15. The device according to claim 14, wherein said low-melting eutectic material is formed by alternating layers of gold and tin.

16. The device according to claim 13, wherein said spacer is of dielectric material.

17. The device according to claim 16, wherein said dielectric material is chosen from among a spun polymer, such as SU8, polyimide, a composite material formed by laminated polymer layers, such as a photosensitive stick foil, and oxynitrides.

18. The device according to claim 13, wherein said spacer also forms a completely enclosed second cavity surrounding said electrically conductive region.

19. The device according to claim 13, further comprising a metal region which extends on top of said second body and beneath said electrically conductive region.

20. The device according to claim 19, wherein said welding region and said metal region are of a material chosen from among titanium, gold and nickel.

27. A device forming an electromechanical or optical microsystem, comprising:

a first body of semiconductor material;

a first metal region, formed on a first surface of the first body;

a second body of semiconductor material spaced apart from the first body;

a spacer separating the first and second body and in contact with the first surface of the first body and a first surface of the second body, the spacer having at least three sides defining a first cavity between the first and second bodies;

a second metal region, formed on a first surface of the second body; and

a connection structure bonded to the first and second metal regions, forming thereby an electrical connection between the first and second metal regions, the connection structure being surrounded by the first cavity.

28. The device of claim 27 wherein the connection structure is a low-melting eutectic material welded to the first and second metal regions.

29. The device of claim 27 wherein, the first and second metal regions and the connection structure are formed within the first cavity defined by the spacer.

30. The device of claim 27 wherein the spacer further defines a completely enclosed second cavity between the first and second bodies, the device further comprising a micromechanical structure formed within the second cavity defined by the spacer.

31. The device of claim 27 wherein the first body of semiconductor material is formed of quartz.

32. The device of claim 31, further comprising a mirror formed on a second surface of the first body.

33. The device of claim 31, further comprising a diffractive lens formed on the second surface of the first body.

35. The device of claim 13, wherein the active region comprises a suspended electromechanical structure.

36. The device of claim 13, wherein the active region comprises an optical structure.

37. The device of claim 36, further comprising a mirror formed on a surface of the first body opposite the optical structure.

38. The device of claim 36, further comprising:

a third body welded to the first body adjacent to the second body; and

an additional spacer formed between the first and third bodies and including a completely enclosed second cavity surrounding an additional active region of the microsystem.

39. The device of claim 38, further comprising first and second mirrors formed on opposite faces of the first body.

40. The device of claim 13 wherein the first and second bodies are wafers of semiconductor material.

55. A device forming an electromechanical or optical microsystem, the device comprising:

a first body;

a second body spaced apart from the first body;

an active region of the microsystem, the active region being positioned between the first and second bodies; and

a single spacer extending between the first and second bodies and including a completely enclosed first cavity that surrounds the active region and that is defined by the spacer and the first and second bodies.

56. The device of claim 55 wherein the single spacer includes a completely enclosed second cavity that is defined by the spacer and the first and second bodies, the device further comprising an electrically conductive region welded between the first and second bodies and positioned in the second cavity.

57. The device of claim 55, further comprising an electrically conductive region welded between the first and second bodies and positioned adjacent to the spacer.

58. The device of claim 55, wherein said electrically conductive region is of a low-melting eutectic material.

59. The device of claim 58, wherein said low-melting eutectic material is formed by alternating layers of gold and tin.

60. The device of claim 55, wherein said spacer is of dielectric material.

61. The device of claim 60, wherein said dielectric material is chosen from among a spun polymer, such as SU8, polyimide, a composite material formed by laminated polymer layers, such as a photosensitive stick foil, and oxynitrides.

62. The device of claim 55 wherein the active region comprises a suspended electromechanical structure.

63. The device of claim 55, wherein the active region comprises an optical structure.

64. The device of claim 63, further comprising a mirror formed on a surface of the first body opposite to the optical structure.

65. The device of claim 55, further comprising:

a third body welded to the first body and adjacent to the second body; and

an additional spacer extending between the first and third bodies and including a completely enclosed second cavity that surrounds an additional active region of the microsystem.

66. The device of claim 55 wherein the first and second bodies are wafers of semiconductor material.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.

Respectfully submitted,

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